26 April 1955
NIE 11-2-55

~~TOP SECRET~~

NATIONAL INTELLIGENCE ESTIMATE
NUMBER 11-2-55

THE SOVIET ATOMIC ENERGY PROGRAM TO MID-1958

(b)(1)
(b)(3)

The Intelligence Advisory Committee concurred in this estimate on 26 April 1955. The FBI abstained, the subject being outside of its jurisdiction.

The following member organizations of the Intelligence Advisory Committee participated with the Central Intelligence Agency in the preparation of this estimate: The intelligence organizations of the Departments of State, the Army, the Navy, the Air Force, the Joint Staff, and the Atomic Energy Commission.

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NATIONAL INTELLIGENCE ESTIMATE

JOINT ATOMIC ENERGY INTELLIGENCE COMMITTEE

THE SOVIET ATOMIC ENERGY PROGRAM

NIE 11-2-55

26 April 1955

This estimate was prepared and agreed upon by the Joint Atomic Energy Intelligence Committee which is composed of representatives of the Departments of State, Army, Navy, Air Force, the Atomic Energy Commission, the Joint Staff and the Central Intelligence Agency. The FBI abstained, the subject being outside of its jurisdiction.

A group of expert consultants working with the Joint Atomic Energy Intelligence Committee concurred in the conclusions. The estimate was approved by the Intelligence Advisory Committee as of 26 April 1955.

USSR: Major Atomic Activities

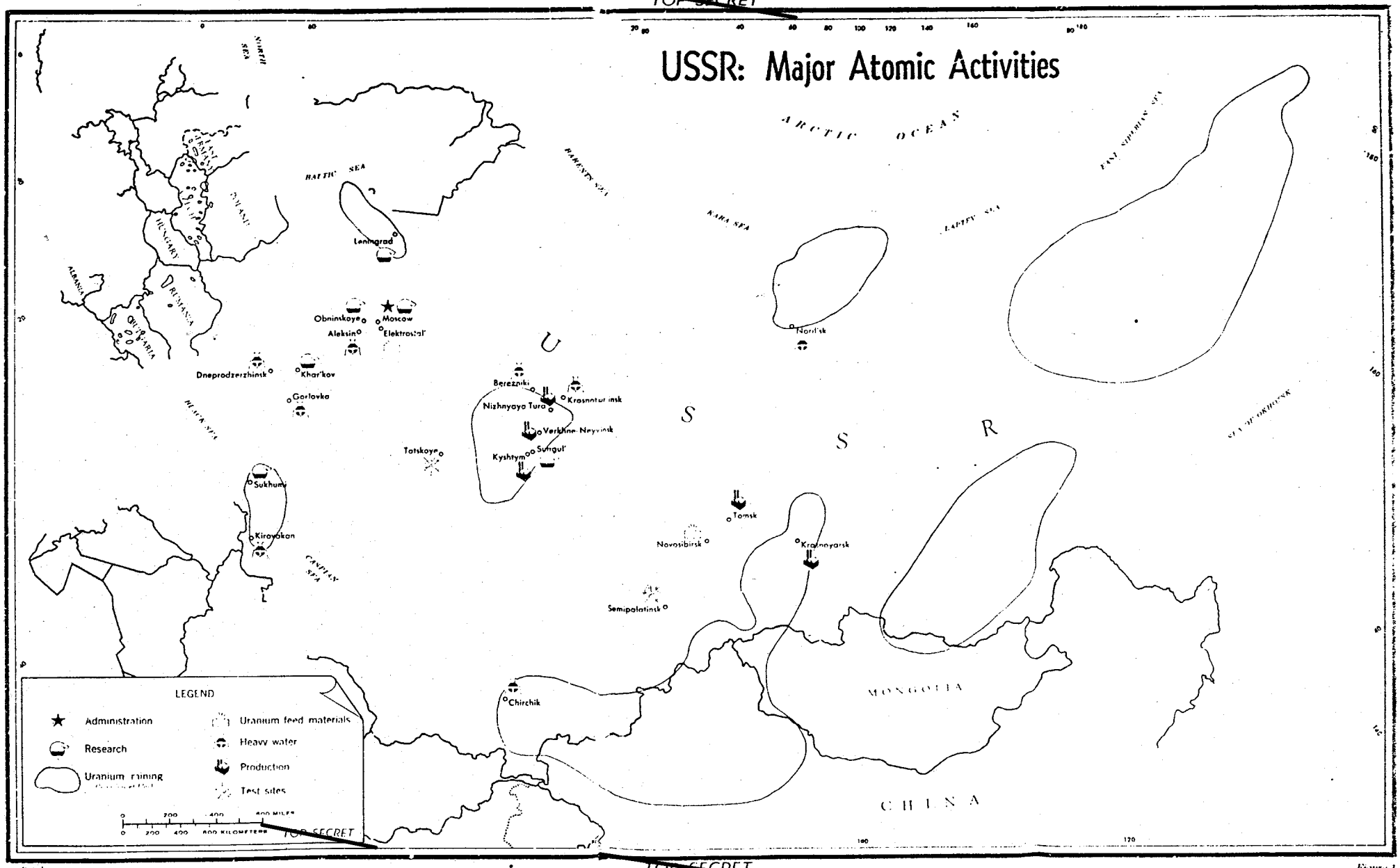


Figure 1

THE SOVIET ATOMIC ENERGY PROGRAM

THE PROBLEM

To estimate the current status and future course of the Soviet atomic energy program on the basis of information available from all sources.

SUMMARY

1. Available evidence establishes the existence in the USSR of (1) a high priority extensive atomic energy program which is continuing to expand; (2) a substantial stockpile of fissionable materials; and (3) the capability of producing explosions in the range from the equivalent of a few kilotons up to approximately 1,000 kilotons of TNT. Thus, while the exact extent of Soviet capability for quantity production of nuclear weapons remains uncertain, the general nature and some of the details of the Soviet atomic energy program can be assessed.

2. Evidence received since 1 January 1954 primarily concerns mining and concentration of uranium, production of plutonium, early research and development in uranium-235 isotope separation, the testing of weapons, and military and civilian training and indoctrination in atomic warfare. All of this evidence confirms the broad outlines of the program as estimated in NIE 11-3-54 and permits some definition of particular phases of the program with somewhat more certainty than was heretofore possible.

3. The USSR has carried out extensive independent research and has adapted to its needs atomic energy information obtained from espionage activities, German technical assistance, and unclassified scientific and technical literature available from western countries. The required research was carried out on high priority which made available outstanding scientific personnel, laboratory facilities, and equipment. Top ranking Soviet scientists, both theoretical and experimental, in all pertinent fields, have been identified with the program.

4. It is estimated that a total of approximately 4,000 tons of natural uranium (in terms of recoverable metal) was mined in 1954 in the USSR and its satellites, including East Germany. While this figure is subject to a considerable uncertainty as a result of the inconclusive nature of the evidence on internal USSR efforts, approximately 2,000 tons of this total are estimated to have come from East Germany and this latter figure is considered to be subject to an uncertainty of not more than plus or minus 25 per cent. The estimated 1954 production given above is more than sufficient to support the fissionable material production estimates for the same year given in this report.

5. Knowledge of the status of the Soviet atomic energy program as of the end of 1954 is derived from a considerable volume of evidence, much of it peripheral. However, a sufficient amount is detailed enough to provide a reasonable foundation for quantitative

assessment. Information obtained by technical means on Soviet plutonium production and weapon tests continues to be consistent with information obtained through other sources. Information concerning uranium-235 production does not permit as reliable an estimate as in the case of plutonium production, although Soviet efforts in phases of uranium-235 production are known to be extensive. There is also evidence of the production of thermonuclear material by the Soviet program.

6. On the basis of the test data now available, it is concluded that the USSR is capable of producing nuclear weapons with explosive powers in the range of a few kilotons up to 1,000 kilotons.

[redacted]

It is estimated that during 1955 the USSR could test a multi-megaton thermonuclear device which, if successful, would permit initiation of stockpiling of thermonuclear weapons with yields in the multi-megaton range by mid-1956.

7. On the basis of the capability demonstrated by Soviet nuclear tests and the evaluation of the overall Soviet program, it is concluded that the USSR is actually producing and stockpiling nuclear weapons. It is considered unlikely that the USSR would stockpile thermonuclear weapons or fission weapons of radically new design without a full-scale field test of the nuclear explosive system, although such a possibility cannot be completely discounted.

[redacted]

8. In view of the development of a family of weapon types as indicated in the 1953 and 1954 tests, it is believed that the USSR is not restricting its stockpile to a single class of weapons. However, there is no clear evidence of the numbers of various types

[redacted]

of weapons the USSR is stockpiling. Within the stockpiling principles and technical capabilities outlined above, military requirements will probably govern the allocation of available Soviet fissionable material among various types and yields of weapons.

It should be noted, however, that particularly during the latter part of this period, other allocations of fissionable material to the categories of small, medium and large-yield weapons may be more likely.

9. The figures given in Table I are based on the most probable fissionable material stockpile. In view of the degree of uncertainty applicable to the estimates of fissionable material production, the

actual figures for the weapons stockpile example given above for the end of 1954 (as well as other choices the USSR can make) may be as much as one-third lower or higher. The uncertainty increases as estimates are projected into the future and for mid-1958 the figures may be as low as one-half or as high as twice the figures given.

However, it is improbable that complete conversion of weapons stockpiled will take place during the period to mid-1958.

10. Estimates of Soviet nuclear weapon capabilities and guide lines for long-range projections of Soviet fissionable material stockpiles for the period 1958 through 1965 as well as examples of possible stockpiles during this period are set forth in Part III.

DISCUSSION

PART I

STATUS OF THE SOVIET ATOMIC ENERGY PROGRAM AS OF THE END OF 1954

1. Introduction

a. Available evidence establishes the existence in the USSR of: (1) a high priority extensive atomic energy program which is continuing to expand; (2) a substantial stockpile of fissionable materials; and (3) the capability of producing explosions in the range from the equivalent of a few kilotons up to approximately 1,000 kilotons of TNT. Thus, while the exact extent of Soviet capability for quantity production of nuclear weapons remains uncertain, the general nature and some of the details of the Soviet atomic energy program can be assessed.

b. Evidence received since 1 January 1954 primarily concerns mining and concentration of uranium, production of plutonium, early research and development in uranium-235 isotope separation, the testing of weapons, and military and civilian training and indoctrination in atomic warfare. All of this evidence confirms the broad outlines of the program as estimated in NIE 11-3-54 and permits some definition of particular phases of the program with somewhat more certainty than was heretofore possible.

c. Knowledge of the status of the Soviet atomic energy program as of the end of 1954 is derived from a considerable volume of evidence, much of it peripheral. However, a sufficient amount is detailed enough to provide a reasonable foundation for quantitative assessment. Information obtained by technical means on Soviet plutonium production and weapon tests continues to be consistent with information obtained through other sources. Information concerning uranium-235 production does not permit as reliable as estimate as in the case of plutonium production, although Soviet efforts in phases of uranium-235 production are known to be extensive. There is also evidence of the production of thermonuclear material by the Soviet program.

d. The locations of the principal sites in the Soviet atomic energy program are shown in Figure 1.

2. General Scope of the Program

a. Organization

(1) In November 1945 the "First Chief Directorate attached to the Council of Ministers" was organized, with Beria as responsible minister, to plan and carry out the Soviet atomic energy program.

Research interest exhibited during World War II was thus afforded high priority support and direction. When, in 1950, uranium procurement became a very extensive operation, a "Second Chief Directorate attached to the Council of Ministers" was organized to coordinate uranium prospecting, mining and basic ore concentration efforts. This organizational structure continued without substantial change until the downfall of Beria in 1953. MVD participation has been extensive in some atomic energy activities including construction of the important atomic energy installations, control of mining activities and supervision of the activities of German atomic energy scientists. Coincident with Beria's arrest the Ministry of Medium Machine Building was organized and shortly thereafter Malyshev was designated as minister in charge. Colonel General A. P. Zavenyagin, a key figure in the atomic energy program, was subsequently appointed Minister of Medium Machine Building in March, 1955. The activities of this ministry have not been publicly defined, but there is evidence that it is responsible for at least a part of the Soviet atomic energy program. It is not known whether this ministry or another key organization is responsible for the overall administration, although the recent appointment of Zavenyagin to replace Malyshev appears to place broader responsibility for atomic energy in this ministry. The administrative changes following Beria's arrest do not appear to have adversely affected the progress of the Soviet atomic energy program.

b. Research

(1) The USSR has carried out extensive independent research and has adapted to its needs atomic energy information obtained from espionage activities, German technical assistance, and unclassified scientific and technical literature available from western countries. The required research was carried out on high priority which made available outstanding scientific personnel, laboratory facilities and equipment. Top ranking Soviet scientists, both theoretical and experimental, in all pertinent fields, have been identified with the program. The high caliber of the individuals involved is evident from their scientific publications as well as from the progress made in the Soviet atomic energy program thus far. Available evidence concerning Soviet espionage warrants the inference that Soviet atomic research, plant design, construction and operation were carried out with considerable knowledge of the U.S., U.K., and Canadian atomic energy programs. Although this espionage assisted the early Soviet program by at least establishing guide lines for research, extensive independent research by the USSR was required to accomplish its program. Also, it is evident that in a number of important instances Soviet practices do not follow those of the western countries mentioned.

c. Raw Materials and Resources

(1) There is a considerable body of information available on Soviet activities related to uranium prospecting, mining and ore beneficiation in East Germany and, to a lesser extent, in Czechoslovakia. Much less is known about these activities in the other satellites and still less about activities within the USSR. It is estimated that a total of approximately 4,000 tons of natural uranium (in terms of recoverable metal) was mined in 1954 in the USSR and its satellites, including East Germany. While this figure is subject to a considerable uncertainty as a result of the inconclusive nature of the evidence on internal USSR efforts, approximately 2,000 tons of this total are estimated to have come from East Germany and this latter figure is considered to be subject to an uncertainty of not more than plus or minus 25 per cent. The estimated 1954 production given above is more than sufficient to support the fissionable material production estimates for the same year given in this report.

(2) Estimated annual uranium production and cumulative uranium stockpiles are given in Table II. Areas of uranium mining in the Sino-Soviet Bloc are shown in Figure 1.

(3) In early 1946, after Germany had been thoroughly exploited for heavy water, equipment and personnel, the conversion and installation of equipment in an electrolytic hydrogen section in the major ammonia plant within the USSR was begun to provide for the production of by-product heavy water for atomic energy purposes. Additional facilities, most of which were also installed in synthetic ammonia plants, came into production during 1949 to 1950. Still further expansion of heavy water production facilities appears to have taken place since 1950. Many of the details of this program are known and it is estimated that a capacity of between 60 and 100 tons per year has been achieved.

(4) There is evidence of the procurement by the Soviet atomic energy program of lithium and beryllium, and of the availability of basic materials such as synthetic graphite, structural and stainless steel, aluminum, nickel, and process chemicals. There is also evidence of Soviet atomic energy interest in the exploitation of heavy sand deposits which are known to contain thorium, zirconium, some uranium and other elements useful in atomic energy activities. Utilization of thorium, zirconium or beryllium has not thus far been noted. The available quantities of the metals mentioned above are substantial, and it is believed that such quantities as are required for atomic energy purposes would represent only a small percentage of the total Soviet capacity for producing them and would not impose any burden on the basic Soviet economy.

TABLE II

URANIUM ORE PRODUCTION IN TERMS OF METRIC TONS RECOVERABLE URANIUM

31 December 1954 Estimate

Year	USSR	Germany	Czechoslovakia	Bulgaria	Poland	Rumania	China	Korea	Yearly Total
Stocks Pre-1946	Nominal	170-200	60-70	Nominal	--	--	--	--	230-270
1946	50-100	30-60	10-30	Nominal	--	--	--	--	90-190
1947	150-300	150-200	30-50	10-20	Nominal	--	--	--	340-570
1948	250-400	400-500	100-150	20-30	10-20	--	--	--	780-1100
1949	350-500	800-1200	150-250	40-60	30-50	--	--	Nominal	1370-2060
1950	450-650	1000-1500	250-400	60-100	50-90	--	--	Nominal	1810-2740
1951	600-1100	1500-2500	250-450	70-100	50-100	--	Nominal	Nominal	2470-4250
1952	800-1500	1500-2500	250-550	100-150	50-100	10-50	10-40	Nominal	2720-4890
1953	950-1800	1500-2500	300-550	150-200	40-80	50-80	10-40	Nominal	3000-5250
1954	950-2200	1500-2500	350-650	100-300	25-75	50-150	30-60	Nominal	3005-5935
Cumulative Production to 31 Dec 54	4550-8550	8550-13660	1750-3150	550-960	255-515	110-280	50-140	Nominal	15815-27255
							GRAND TOTAL		16000-27000

3. Nuclear Material Production

a. Fissionable material production sites are located in the Urals area and in Central Siberia. The history of the construction of the plants involved is generally clear from a variety of evidence. However, important details remain undetermined and thus introduce a measure of uncertainty in the estimates of production to the end of 1954.

(1) Plutonium

The Plutonium estimate which follows is based on a large body of evidence. This is supported by considerable information on the timetable of developments indicated by tests and site construction and the estimated availability of heavy water and uranium.

(2) Uranium-235

The uranium-235 estimate given below is based on an appreciation of information on Soviet research on specific processes, the timetable of developments indicated by tests and site construction, estimated availability of electric power at appropriate sites and the estimated production of nickel wire mesh.

(3) Soviet fissionable material cumulative stockpiles to the end of 1954 are estimated as follows:

Date	Plutonium	Uranium-235
Mid-1949	10 kilograms	--
Mid-1950	50 kilograms	--
Mid-1951	100 kilograms	30 kilograms
Mid-1952	300 kilograms	150 kilograms
Mid-1953	600 kilograms	350 kilograms
Mid-1954	1,200 kilograms	900 kilograms
End of 1954	1,500 kilograms	1,500 kilograms

(4) Uncertainty

It is estimated that the actual figures for the Soviet stockpile of fissionable materials considered as a whole as of the end of 1954 are probably not more than one-third higher or lower than the figures given above.

b. Tritium

[redacted] Production of this material by irradiation of lithium in reactors would compete with other production, such as initiator materials and uranium-233, for the utilization of available excess reactivity. [redacted]

c. Uranium-233

Uranium-233 (the fissionable material produced by neutron irradiation of thorium) has not been employed in the Soviet weapons tests detected to date. Soviet interest in heavy sand deposits which contain thorium and other elements useful in an atomic energy program is referred to in Section 2 c (4) above, indicating the possible existence of plans to utilize thorium in the program. However, there is no evidence that thorium is, in fact, being used in connection with Soviet reactors or that uranium-233 has been produced.

4. Military Applications

a. The USSR now has a large atomic energy program in operation directed toward the development and production of nuclear weapons. This has been evident in the form of the fourteen nuclear tests which have been detected. No clear evidence is available on the extent of Soviet efforts to develop nuclear power installations or propulsion for military applications. However, in view of the increasing size of Soviet fissionable material stockpiles and the interest in the non-military power applications of atomic energy, some effort is undoubtedly being expended on the military aspects of these problems.

b. Nuclear Weapons Development

(1) The course of Soviet nuclear weapons development and a reasonable estimate of the competence and accomplishments of the personnel involved can be drawn from a consideration of the data on nuclear tests conducted by the USSR. In the 14 detected tests,

plutonium, composite (plutonium and uranium-235), and boosted types have been exploded. Approximate values of relevant data and calculated physical characteristics are summarized in Table III.

(2) The first Soviet nuclear test was conducted in 1949 and was followed by test series in 1951, 1953 and 1954. The test explosion in 1949 clearly marks the start of the growth of Soviet nuclear weapon capabilities and appears to have been conducted as soon as sufficient plutonium was available. This test, yielded approximately 10 kilotons

(3) In the four explosions detected in the 1953 test series, continued development and expansion of Soviet weapon capabilities was evident.

(4) Seven explosions were detected in the 1954 test series. The first test occurred at a new location, Totskoye, east of Kuybyshev, and appears to have been the detonation of a stockpile weapon as part of a military demonstration. The remaining six tests occurred at the normal Soviet proving ground in the vicinity of Semipalatinsk. All of the explosions involved yields of less than 100 kilotons.

TABLE III

SOVIET TEST DATA

NO.	DATE	YIELD (KT)
I	Aug 29 '49	10
II	Sept 24 '51	45
III	Oct 18 '51	50
IV	Aug 12 '53	500-1000
V	Aug 23 '53	25
VI	Sept 3 '53	10
VII	Sept 10 '53	6
VIII	Sept 14 '54	45
IX	Oct 3 '54	7
X	Oct 5 '54	Less than 40
XI	Oct 8 '54	Less than 20
XII	Oct 23 '54	70
XIII	Oct 26 '54	5-10
XIV	Oct 30 '54	35

[redacted]

[redacted]

There is also, among others, the possibility that the USSR, being aware of the difficulties inherent in widespread down-wind fall-out of radioactive debris, elected not to carry out a multi-megaton test as part of the 1954 test series at their Semipalatinsk proving ground.

[redacted]

c. Weapon Stockpiles

(1) On the basis of the test data now available, it is concluded that the USSR is capable of producing nuclear weapons with explosive powers in the range of a few kilotons up to 1,000 kilotons. It is considered unlikely that the USSR would stockpile thermonuclear weapons or fission weapons of radically new design without a full-scale field test of the nuclear explosive system, although such a possibility cannot be completely discounted. The 14 tests detected to date (See Table III) afford guidance to the types which now may be stockpiled.

[redacted]

[redacted]

[redacted]

(2) In view of the development of a family of weapon types as indicated in the 1953 and 1954 tests, it is believed that the USSR is not restricting its stockpile to a single class of weapons. However, there is no clear evidence of the numbers of various types of weapons the USSR is stockpiling. Within the stockpiling principles and technical capabilities outlined above, military requirements will probably govern the allocation of available Soviet fissionable material among various types and yields of weapons.

[redacted]

[redacted]

(4) The figures given above are based on the most probable fissionable material stockpile. In view of the degree of uncertainty applicable to the estimate of fissionable material

[redacted]

production, the figures for the weapons stockpile example are given above for the end of 1954 (as well as other choices the USSR can make) may be as much as one-third lower or higher.

PART II

THE COURSE OF THE SOVIET ATOMIC ENERGY PROGRAM FROM 1955 THROUGH MID-1958

1. Introduction

a. In the absence of definite information on Soviet atomic energy plans, broad indicators must be used to predict the direction of future growth. There are several such indicators that are helpful in considering the Soviet program, such as:

(1) The growth of production capability.

(2) The general raw material picture, level of industrial development, and availability of basic materials and electric power, all or any of which are factors that may limit the size of the program at any given time and may dictate the direction of development.

(3) The size of the scientific and technical manpower pool, general scientific competence, technical originality, and ingenuity. These factors are helpful in assessing whether the program is likely to follow the pattern set by other countries or to branch off in an entirely new and original direction.

b. In estimating future expansion of the Soviet atomic energy program, the range of possibilities is very great. The upper limit would be set by the availability of essential materials, technological development, and the basic industrial-economic capabilities of the Soviet Union. A lower limit would be defined by a Soviet decision to carry out no further expansion beyond installed capacities at the beginning of 1955.

2. General Future Course of the Program

a. The main emphasis of the Soviet program will almost certainly continue to be on military applications--primarily weapons unless there is a significant change in international relations.

[redacted] The USSR will probably also continue work on small-yield, small-dimension weapons. Further developments along both of the above lines could be tested during 1955.

b. It seems obvious that the USSR will work toward the development of a plutonium and uranium-235 production program consistent with its

requirements. The planned balance between plutonium and uranium-235 production and the part that uranium-233 may play in the Soviet weapons program are not known. Research and development required for fissionable material production will continue, possibly including work on uranium-233. The development by the USSR of other methods for producing plutonium, for example, through the use of accelerators or controlled thermonuclear reactions, cannot be excluded, although there is no evidence of related Soviet research.

c. The USSR has the technical competence and materials required for research and development in the application of atomic energy to submarine propulsion. However, there is no evidence (other than that relating to the existence of a power plant utilizing atomic energy) that the USSR is engaged in research or development along these lines. Nevertheless, it is considered possible for the USSR to have a prototype propulsion reactor installed in a submarine at any time during the period of this estimate.

d. There is no evidence of Soviet activities related to nuclear propulsion of aircraft. Even if such a program exists it is considered unlikely, on the basis of the estimated status of Soviet atomic energy developments, that the USSR will by 1958 progress beyond the research and development stage on nuclear propulsion units for aircraft.

e. Some effort will undoubtedly continue to be expended by the USSR on the peaceful applications of atomic energy, including power applications. However, it is unlikely that such a program would require a significant diversion of efforts or materials from the military applications. Work on the use of radioisotopes in medical, biological and other research and for industrial applications will probably also continue. Radioisotopes will continue to be made available by the USSR to Soviet Bloc countries, and more offers of such materials as well as technical assistance will very likely be made by them to uncommitted countries and possibly to pro-Western countries during the next several years.

3. Research and Development Capability

a. A large number of highly qualified scientists have been identified with the Soviet atomic energy program. Their high caliber is evident from the early accomplishment of key phases of the program. Their ability to do independent work is attested to by the approach taken in certain aspects of both weapon development and fissionable material production. There does not appear to have been any reduction in the high priority assigned to atomic energy research and, as a consequence, no decrease is expected through mid-1958 in the number of

scientific and technical personnel assigned to the program.

4. Raw Materials

a. Uranium

(1) The success of the USSR to date in obtaining more uranium than it processed into fissionable materials reflects its ability and willingness to exploit, on a large scale, even low grade uranium deposits, and thus leads to the conclusion that uranium will not be a limiting factor on the growth of the program during the period of this estimate. In fact, uranium obtained from East Germany alone would have been amply sufficient to support the program to date and will probably constitute at least a substantial proportion of Soviet supplies for some time to come. However, even if East German uranium ceased to be available to the USSR, no significant impairment of estimated Soviet fissionable material production would ensue.

(2) East German uranium output has been fairly constant for several years and will probably not increase in the 1955-1958 period. Exploitation of uranium deposits in other Satellites, and China, has been increasing. Figure I, Part I, shows the areas of interest in the Soviet uranium mining program. Uranium reserves within the USSR appear to be sufficient to support a much larger program, but exploitation rates will depend on the balance decided upon by the USSR between atomic energy and other activities.

(3) In considering uranium availability to the Soviet program, the possibility of increasing the utilization of uranium by various methods, in addition to those discussed in Section 2b (Part II) above, must not be overlooked. From the irradiation level of the plutonium utilized in recent tests, there is clear evidence that the USSR has increased the irradiation level of uranium in its reactors well above the initial level, and operation is probably now at approximately 350 grams of plutonium per ton of uranium. The third test of the 1953 series indicates at least an interest in the possibility of using even higher irradiation levels; i.e., approximately 800 grams of plutonium per ton of uranium. Furthermore, Soviet interest in the possibility of reutilization of uranium after pile irradiation must be noted, although evidence is not available on whether the USSR has undertaken this technique.

b. Heavy Water

The program initiated in 1945 looking toward large-scale production of heavy water by mid-1950 now represents a capability for the production of approximately 60 to 100 tons a year. This program appears to have

been based on a substantial plant investment by the First Chief Directorate and, for this and other reasons, it is expected that production of heavy water will continue at least at this rate during the period 1955 through 1958, and may possibly increase.

c. Other Materials

Soviet interest in other materials of significance is atomic applications referred to in Section 2 c (4), Part I. The availability of thorium, zirconium, lithium, beryllium, and synthetic graphite is noted to be fairly well established. The USSR possesses the scientific and technical capability to devise required production-scale purification and processing techniques to permit utilization of these materials for atomic energy purposes. As a consequence, the production of uranium-233 or tritium, or the development of reactors for power or propulsion, if undertaken, would not be impeded by a shortage of basic materials during the period of this estimate.

5. Nuclear Material Production

a. Although the estimate of current Soviet production of fissionable materials is supported by quantitative evidence, there is no direct information available on the scope of Soviet plans for expansion of production facilities. There are, however, indications of Soviet intentions to expand their atomic energy program. For example, it is known that the high priority provided for the program continued through 1954 and that construction activities continued at major technical atomic energy sites. It is also estimated that the USSR has achieved a capacity to produce approximately 60 to 100 metric tons of heavy water per year as a result of a series of construction projects which appear to have long-range significance.

b. Plutonium

It is estimated that by 1958 there will be an increase in plutonium production rate to approximately 1000 kilograms per year as compared to the rate of 600 kilograms per year which was probably effective during the period mid-1953 to mid-1954. This increase is not intended to define the maximum capability for expansion of Soviet plutonium manufacturing facilities, nor can the availability of heavy water be considered a limiting factor in this regard. Expansion is possible, for example, by increasing the power levels of reactors now producing plutonium. Likewise, the construction of graphite-moderated reactors or the development of the other methods for plutonium production may contribute to further expansion without increasing requirements for heavy water.

c. Uranium-235

There is no information on Soviet plans for future uranium-235 production or on the expansion of present uranium-235 facilities. In addition, in comparison with current estimates of plutonium production, the basis for the estimate of current uranium-235 production is not as firm. However, as indicated above, the Soviet atomic energy program appears to be an expanding one in which uranium-235 has a significant role.

d. On the basis of the above, it is estimated that the Soviet fissionable material program will continue to expand during the period of this estimate, that it will follow the general pattern set in the past and that stockpiles to mid-1958 will be:

DATE	PLUTONIUM	URANIUM-235
End 1954	1,500 kilograms	1,500 kilograms
Mid-1955	1,900 kilograms	2,100 kilograms
Mid-1956	2,700 kilograms	3,500 kilograms
Mid-1957	3,600 kilograms	5,200 kilograms
Mid-1958	4,600 kilograms	7,200 kilograms

e. Uncertainty

It is estimated that the actual figures for the Soviet stockpile of fissionable materials considered as a whole as of the end of 1954 are probably not more than one-third higher or lower than the figures given above. The uncertainty increases as estimates are projected into the future, but even for mid-1958, the actual figures may be as low as one-half or as high as twice the figures given.

6. Weapons Program

a. For the immediate future the USSR will probably stockpile weapons of the general characteristics and explosive powers of the types already tested. Soviet weapon research will probably have as objectives the development of weapons with energy yields in excess of 1,000 kilotons and the further development of small-yield, small-size weapons.

b. It is estimated that during 1955 the USSR could test a multi-megaton thermonuclear device which, if successful, would permit initiation of stockpiling of thermonuclear weapons with yields in the multi-megaton range by mid-1956.

It is considered unlikely that the USSR would stockpile weapons of this type without prior field test of the basic principles involved (See Part II, Section 2 a), although such a possibility cannot be completely discounted.

d. It follows from the above that great variety can exist in the allocations of fissionable materials stockpiles which may be made to the various types of weapons the USSR will be capable of producing during the period to mid-1958. Actual allocations will depend upon many factors including specific applications and delivery systems. Furthermore, a wide range of yields may be achieved in the yield categories of small, medium and large which are within Soviet capabilities.

e. In the absence of clear evidence which can serve as a guide to the specific types and numbers of each type of nuclear weapons which the USSR will actually stockpile, the nuclear weapons stockpile which follows is presented for comparison with the current estimate of the Soviet stockpile set forth in Part I, Section 4 c.

It should be noted that during the latter part of the period mentioned other allocations of fissionable material to small, medium and large-yield categories may be more likely; for example, the allocation given in Part III, Section 7. In addition, other weapons yields are or will be within Soviet capabilities and the weapon types actually stockpiled may be chosen accordingly.

f. The figures given in Table IV are based on the most probable fissionable material stockpile. In view of the degree of uncertainty applicable to the estimate of fissionable material production, the figures for the weapons stockpile example given above for the end of 1954 (as well as other choices the USSR can make) may be as much as one-third lower or higher. The uncertainty increases as estimates are projected into the future, and for mid-1958 the figures may be as low as one-half or as high as twice the figures given.

However, it is improbable that complete conversion of weapons stockpiled will take place during the period to mid-1958.

PART III

WEAPON CAPABILITIES AND LONG RANGE ESTIMATES

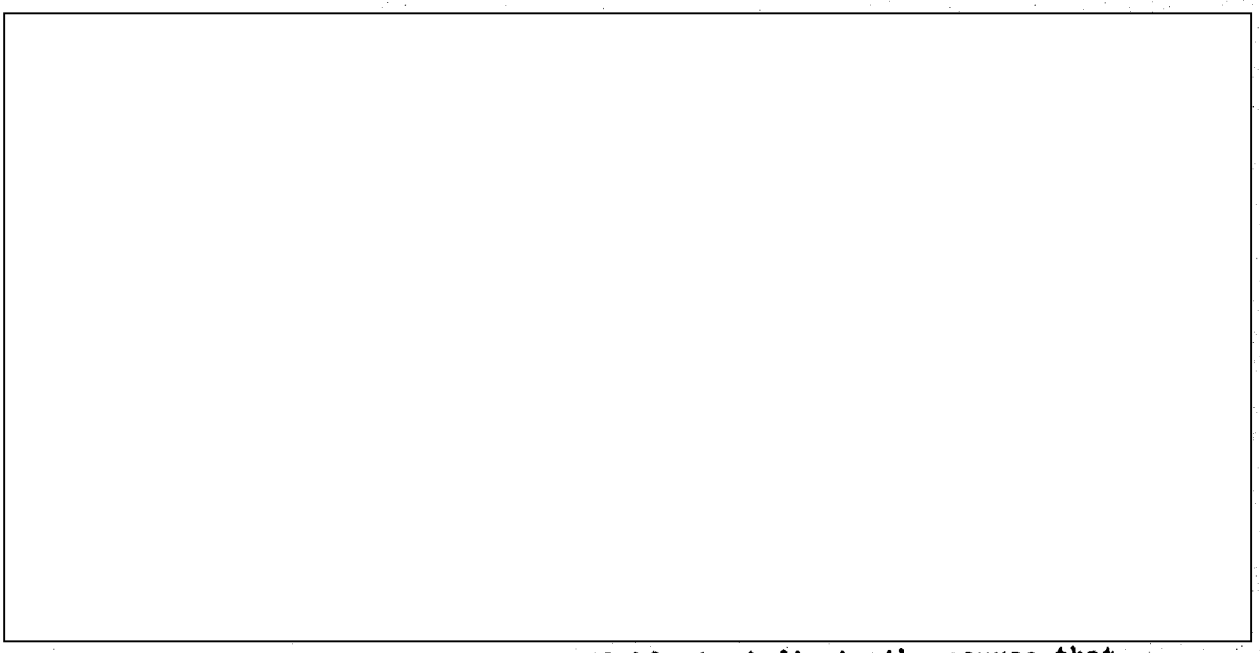
1. In the following sections, estimates of various aspects of Soviet nuclear weapons capabilities are tabulated. In addition, guide lines are given for long range projections of Soviet fissionable material stockpiles for the period 1958 through 1965 and examples of possible Soviet weapon stockpiles are calculated on the basis of these projections.

2. The portions of the tabulations given below which deal with Soviet fissionable material production capabilities up to mid-1958 are based upon the information and estimates given in Parts I and II and the uncertainties there expressed are applicable. Soviet fissionable material production capabilities for the period beyond mid-1958 are subject to even greater uncertainty in view of the lack of information on long range plans and the unpredictability of new developments in this field.

3. Considering the complete lack of information on specific future Soviet plans for weapon developments, it has been necessary to utilize current and projected U. S. developments and timetables in this field and the assessment of Soviet accomplishments to the end of 1954 as guides in estimating future Soviet capabilities.

4. In using the tables, it should be noted that various parameters of nuclear weapons are interdependent. Diameters and weights are related to energy yields as are quantities of fissionable material or mode of operation.

5. Estimated ranges of yields for various amounts of fissionable material in various geometries and weights considered to be within Soviet capabilities are given in Table V.

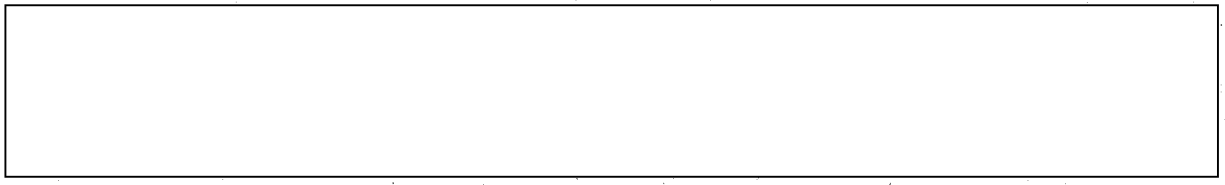


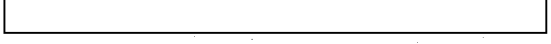
b. There is no evidence available to indicate the course that the Soviet atomic energy program will take during the period 1958 through 1965, nor are there any specific parameters to which the growth of the program during this period can be tied. However, the estimates set forth in Parts I and II of the present report provide a base from which it is possible to project, in a general way, possible growth of Soviet nuclear capabilities beyond mid-1958. Long-range extrapolations can be carried out on the basis of assumptions of the growth pattern the program could follow during the period in question. Alternate assumptions, which indicate a range of growth capabilities, are:

(1) No expansion of Soviet fissionable materials production facilities after 1948 (Assumption A); or,

(2) Continued expansion of Soviet fissionable materials production facilities after 1948 at the same rate as estimates for the period 1949 to mid-1958 (Assumption B); or,

(3) Expansion of the Soviet program after 1958 at a rate which will increase its requirements for uranium to approximately 7,000 to 10,000 tons per year by 1964 (Assumption C).





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7. In view of the broad spectrum of weapon types which will probably be available to the Soviet Union, it becomes increasingly difficult to make specific estimates of the detailed make-up of the Soviet stockpile as it is projected into the future.

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It is to be noted that the above allocation of fissionable material reflects possible future Soviet capabilities for weapon designs, particularly in the amounts of fissionable material used and the yields therefrom, for the large-yield and small-yield weapons. The range of yields in the above classes of weapons reflects, on the one hand, weapon models designed for specific applications and different delivery systems; and, on the other hand, variations in the amount of fissionable material utilized in specific types of weapons. The weights and dimensions of actual weapons and warheads will be governed by the parameters enforced by available delivery systems. These weight and dimensional characteristics will, in turn, determine the yield obtainable from a given amount of fissionable material in a specific type of weapon. (See Table VII).

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